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(56) Documents Cited
GB 2243943 A US 4900985 A

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UK CL (Edition L) H1D DK
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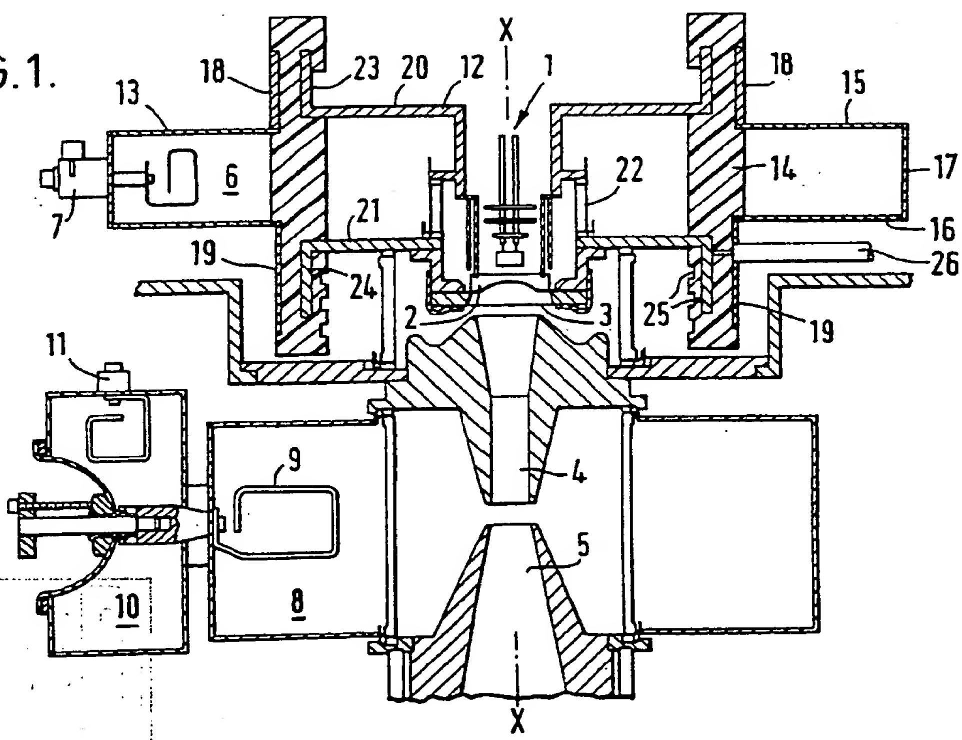
(54) Linear electron beam tube with an insulated and R.F. shielding flange arrangement

(57) A linear electron beam tube such as an IOT includes an input cavity 6 formed from an inner body portion 12 and an outer body portion 13 which are joined together by a generally cylindrical electrical insulator 14. The input cavity 6 surrounds an electron gun 1 and permits electrical connection to be made to the cathode 2 and grid 3 via parts of the inner body portion 20 and 21. The construction enables high voltage parts of the arrangement to be insulated from the low voltage outer body portion whilst presenting a low leakage path for r.f. energy within the cavity 6.

FIG.1.



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At least one drawing riginally filed was informal and the print reproduced here is tak n fr m a later filed formal copy.

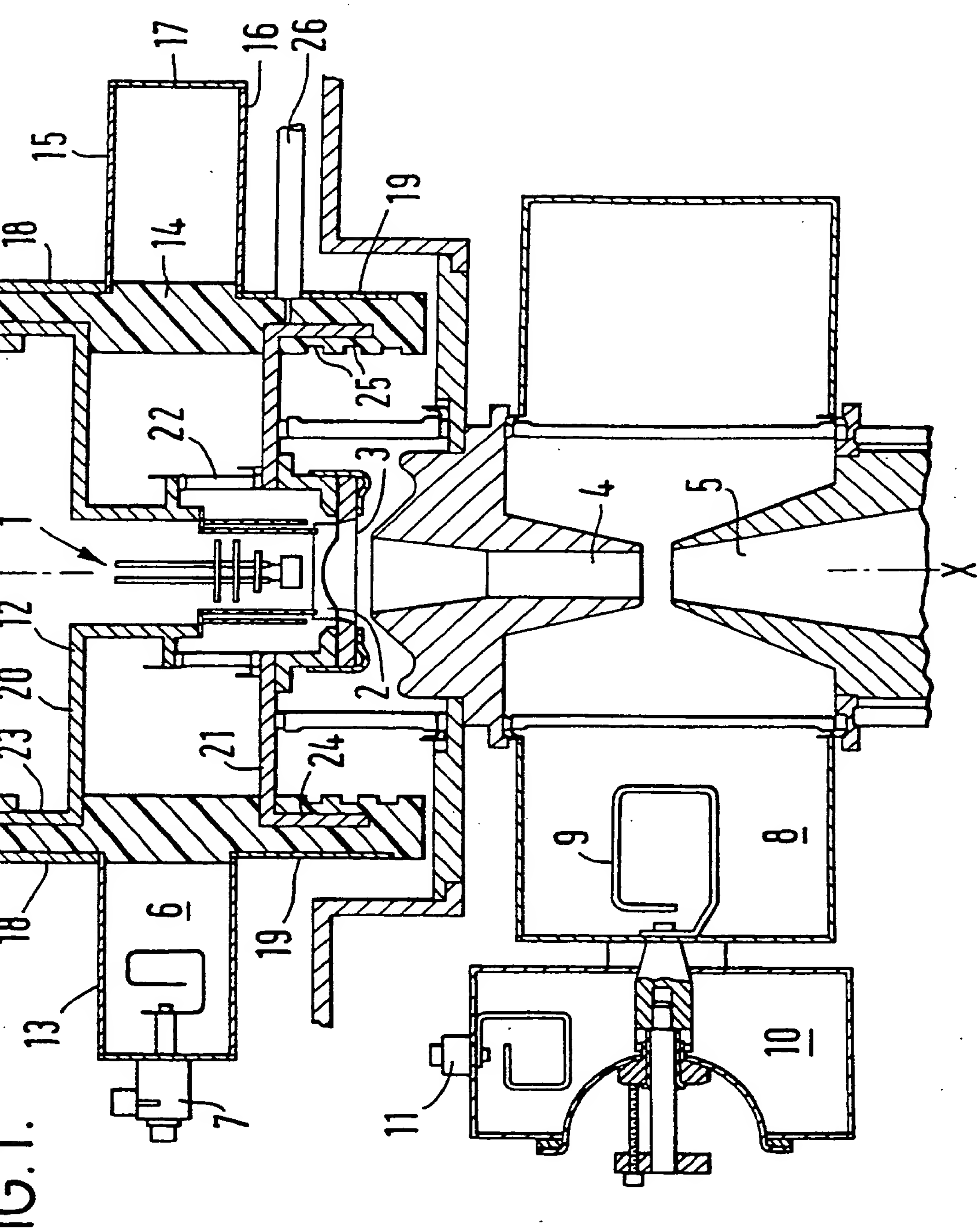

FIG.1.

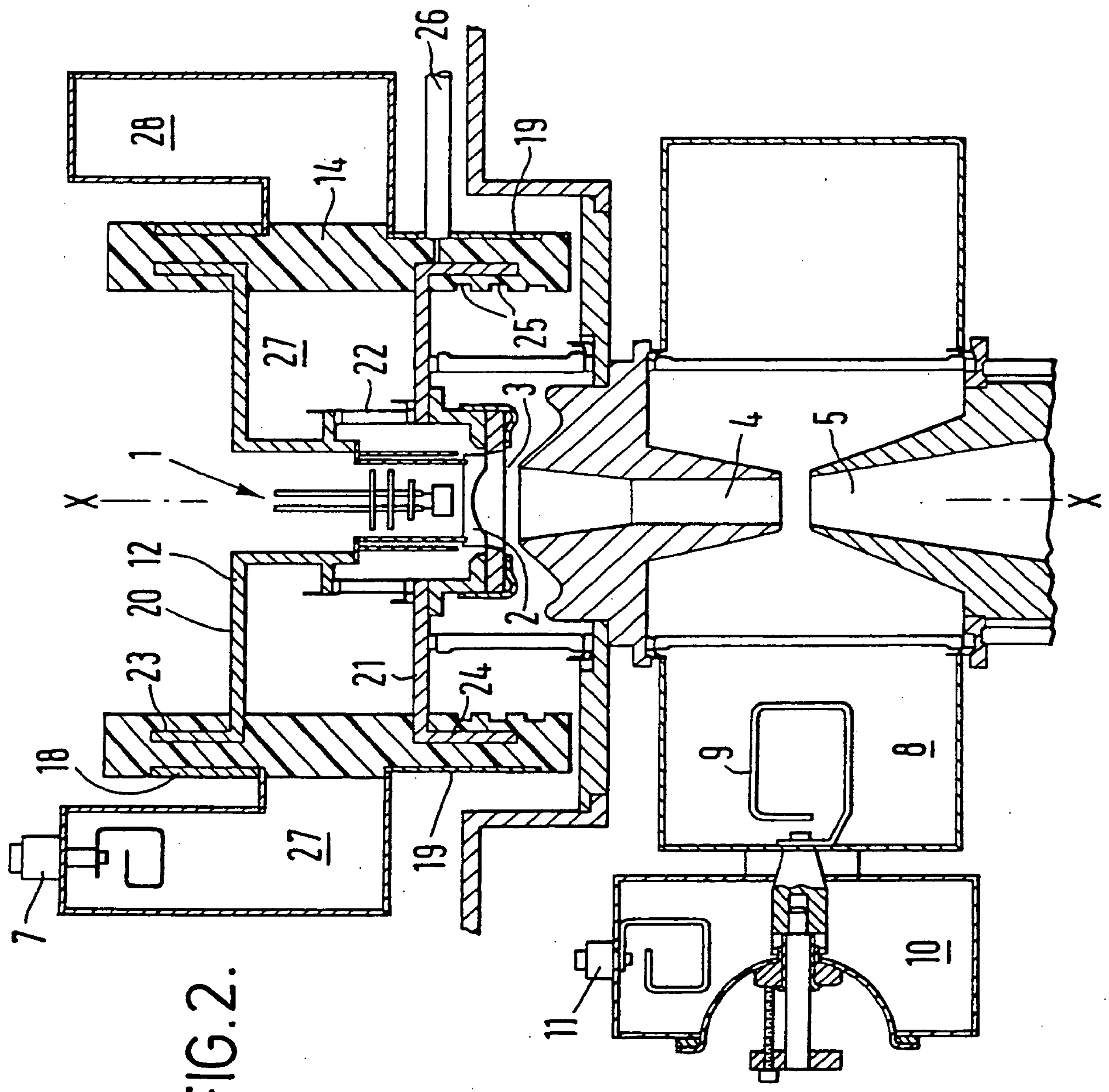

FIG.2.

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Electron Beam Tubes

This invention relates to electron beam tubes and more particularly to input resonator cavities of such tubes at which high frequency energy is applied.

The present invention is particularly applicable to inductive output tetrode devices (hereinafter referred to as "IOT's") such as those referred to by the trade name Klystrode (Registered Trade Mark, Varian Associates Inc.)

An IOT device includes an electron gun arranged to produce a linear electron beam and an input resonant cavity at which an r.f. signal to be amplified is applied to produce modulation of the beam at a grid of the electron gun. The resultant interaction between the r.f. energy and the electron beam causes amplification of the high frequency signal which is then extracted from an output resonant cavity.

During operation of the tube, electrodes of the electron gun must be operated at relatively high voltages, of the order of tens of kilovolts, and this may cause problems, especially as the input cavity may form an external part of the IOT and therefore be handled during normal usage of the device. The present invention arose from an attempt to provide an improved IOT input cavity arrangement but is also applicable to other types of linear electron beam devices having input resonant cavities.

According to the invention, there is provided a linear electron beam tube comprising:

an input cavity which is substantially cylindrical about a longitudinal axis and arranged to receive, in use, a high frequency signal to be amplified;

an electron gun arranged to produce an electron beam in a substantially longitudinal direction; and

an output cavity from which the amplified high frequency signal is extracted; wherein

the input cavity substantially surrounds the electron gun and comprises an inner body portion electrically connected to part of the electron gun and an outer body portion electrically insulated from the inner body portion, the inner body portion being maintained at a relatively high voltage compared to that of the outer body portion, and

wherein thc inner and outer body portions each include an axially extensive flange substantially coextensive in an axially direction and electrically insulating material being located between the flanges.

By "high voltage" it is meant of the order of tens of kilovolts.

The use of the invention enables parts of a linear electron beam tube which operate at relatively high voltages to be located such that they are not readily accessible during normal operation of the tube. In addition, the arrangement of the flanges of the inner and outer body portions enables the two portions to be separated to achieve the desired electrical isolation between them whilst permitting the input cavity to be such that there is low r.f. leakage from it, thereby affording efficient operation. Also, the flanges extend in substantially the same direction and hence are substantially parallel to each other. This is particularly advantageous as it reduces electrical stresses and therefore the tendency of voltage

breakdown to occur between the inner and outer body portions, even at high voltages. Furthermore, the arrangement of the inner and outer body portions and axially extensive flanges is relatively easy, and therefore inexpensive, to fabricate and assemble.

It is preferred that the flanges are substantially cylindrical, as this is a symmetrical configuration which is usually desirable in linear electron beam tubes as it gives good electrical characteristics and results in a mechanically robust arrangement.

Preferably, each of the inner and outer body portions includes two flanges extensive in an axial direction outwardly from the input cavity, there thus being two pairs of co-extensive flanges. Such an arrangement minimizes r.f. losses in the region between the inner and outer body portions. Although the input cavity could alternatively comprise only one pair of flanges, this would tend to result in an r.f. leakage path being present between other parts of the cavity.

It is preferred that the inner body portion comprises two sections which are electrically separate from one another. Again, this facilitates manufacture and assembly and advantageously also permits different voltages to be applied to different parts of the electron gun via the inner body portion. In one preferred embodiment of the invention, the inner body portion is electrically connected to a cathode and a grid of the electron gun. Where two sections are included, one of them may be physically and electrically connected to the cathode and the other to the grid.

Advantageously, the electrically insulating material is generally cylindrical in form.

This permits insulation to be distributed in a symmetrical manner around the longitudinal axis of the tube and also may provide mechanical support and rigidity. Where two pairs of flanges are included in the arrangement, the electrically insulating material may be present as two separate rings, for example, one ring being interposed between one pair of flanges and the other between the other pair. Alternatively, and preferably, the electrically insulating material is a unitary member which is extensive between both pairs of flanges.

Advantageously, the inner and outer body portions are physically joined together by the electrically insulating material which may, for example, be moulded into a particular shape.

Preferably, the outer body portion is at ground potential.

Some ways in which the invention may be performed are now described by way of example with the reference to the accompanying drawings in which:

Figure 1 is a schematic sectional view of an IOT in accordance with the present invention, some parts of which have been omitted for sake of clarity; and

Figure 2 schematically illustrates another IOT in accordance with the invention.

With reference to Figure 1, an IOT comprises an electron gun 1 which includes a cathode 2 and grid 3 arranged to produce an electron beam along the longitudinal axis X-X of the arrangement. The IOT includes drift tubes 4 and 5 via which the electron beam passes before being collected by a collector (not shown). A cylindrical input resonant cavity 6 is

arranged coaxially about the electron gun 1 and includes an input coupling 7 at which an r.f. signal to be amplified is applied. An output cavity 8 surrounds the drift tubes 4 and 5 and includes a coupling loop 9 via which an amplified r.f. signal is extracted and coupled into a secondary output cavity 10 and an output coupling 11.

During operation of this device, the cathode 2 and grid 3 are maintained at potentials of the order of 30kV, the grid 3 being maintained at a dc bias voltage at about 100 volts less than the cathode potential. The input high frequency signal applied at 7 results in an r.f. voltage of a few hundred volts being produced between the cathode 2 and the grid 3.

The input cavity 6 is defined by an inner body portion 12 and an outer body portion 13 with a substantially cylindrical moulded insulating member 14 between them, the inner body portion 12 being electrically insulated from the outer body portion 13 by the intervening dielectric material 14. The outer body portion 13 is maintained at substantially ground potential, thus facilitating safe handling of device, whilst the inner body portion 12 is maintained at much higher voltages.

The outer body portion consists of two annular plates 15 and 16 arranged parallel to one another and transverse to the longitudinal axis X-X with a cylindrical outer wall 17 defining the outer extent of the cavity 6. The inner part of the outer body portion 13 includes two cylindrical flanges 18 and 19 extending outwardly from the cavity volume and arranged cylindrically about the axis X-X.

The inner body portion 12 comprises two sections. The first section 20 is

mechanically and electrically connected to the cathode 2 and the second section 21 is mechanically and electrically connected to the grid 3. In the embodiment shown, a ceramic cylinder 22 is located between the sections 20 and 21 to give additional mechanical support to the assembly.

The inner body portion 12 also includes cylindrical flanges 23 and 24 which extend outwardly away from the input cavity 6 and are arranged coaxially about the axis X-X and within the flanges 18 and 19 of the outer body portion 13. The two pairs of flanges 18 and 23, and 19 and 24 are arranged to extend substantially parallel to one another and are substantially co-extensive in the axial direction. The outer flanges 18 and 19 are located in shallow channels in the outer surface of the dielectric member 14. The inner flange 23 which is connected to the cathode 2 is partially embedded within the member 14 and the other inner flange 24 is substantially wholly embedded within it.

The inner surface of the member 14 includes circumferential grooves 25 around the cathode 2 and grid 3 regions to improve voltage hold off ability. However, in other embodiments, this surface may be smooth.

A power lead 26 is routed via an aperture in the flange 19 and through the dielectric material 14 to supply the grid 3 with the appropriate bias voltage whilst maintaining the electrical insulation of the exterior body portion 13, the connection being made via the lead 26 to the section 21.

Another IOT is shown in Figure 2 and is similar to the Figure 1 arrangement.

However, in this device, the input cavity 27 includes an axially extensive portion 28 which forms part of the outer body portion.

Claims

1. A linear electron beam tube comprising:

an input cavity which is substantially cylindrical about a longitudinal axis and arranged to receive, in use, a high frequency signal to be amplified;

an electron gun arranged to produce an electron beam in a substantially longitudinal direction; and

an output cavity from which the amplified high frequency signal is extracted; wherein

the input cavity substantially surrounds the electron gun and comprises an inner body portion electrically connected to part of the electron gun and an outer body portion electrically insulated from the inner body portion, the inner body portion being maintained at a relatively high voltage compared to that of the outer body portion, and

wherein the inner and outer body portions each include an axially extensive flange substantially co-extensive in an axial direction and electrically insulating material being located between the flanges.

2. A tube as claimed in claim 1 wherein the flanges are substantially cylindrical.

3. A tube as claimed in claim 1 or 2 wherein each of the inner and outer body portions includes two flanges extensive in an axial direction outwardly from the input cavity.

4. A tube as claimed in claim 3 wherein the insulating material is in the form of a single member which is extensive between both pairs of flanges.

5. A tube as claimed in claim 1, 2, 3 or 4 wherein the inner body portion comprises two sections which are electrically separate from one another.

6. A tube as claimed in any preceding claim wherein the inner body portion is electrically connected to a cathode and a grid of the electron gun.

7. A tube as claimed in any preceding claim wherein the electrically insulating material is generally cylindrical in form.

8. An arrangement as claimed in any preceding claim wherein the inner and outer body portions are physically joined together by the electrically insulating material.

9. A tube as claimed in any preceding claim wherein the outer body portion is at ground potential.

10. A tube as claimed in any preceding claim wherein electrical connection is provided between the outside of the input cavity and the inner body portion through the insulating material.

11. An arrangement as claimed in any preceding claim wherein at least one of the flanges is embedded in the electrically insulating material.

12. An arrangement as claimed in any preceding claim wherein a surface of the electrically insulating material includes at least one circumferential groove.

13. A linear electron beam tube substantially as illustrated and described with reference to Figure 1 or 2 of the accompanying drawing.

Patents Act 1977
Examiner's report to the Comptroller under Section 17 (The Search Report)

Application number

GB 9307552.1

Relevant Technical fields

(i) UK Cl (Edition L) H1D (DK)

(ii) Int Cl (Edition 5) H01J

Databases (see over)

(i) UK Patent Office

(ii)

Search Examiner

J A WATT

Date of Search

27 AUGUST 1993

Documents considered relevant following a search in respect of claims 1-13

Category (see over)	Identity of document and relevant passages	Relevant to claim(s)
Y	GB 2243943 A (EEV) whole document	1 at least
Y	US 4900985 A (TOSHIBA) whole document	1 at least

Category	Identity of document and relevant passages	Relevant to claim(s)

Cat gories of documents

X: Document indicating lack of novelty or of inventive step.

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&: Member of the same patent family, corresponding document.

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